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Hypertension and appraisal of physical and psychological stressors

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Abstract

Objective: In the operant conditioning of hypertension hypothesis, it is assumed that the frequently found diminished sensitivity to painful stimuli in hypertensives can be generalized to sensitivity to other stressors, including psychological stressors. The validity of this assumption is examined in the present study. **Methods:** Unmedicated hypertensives (42) and normotensive controls (21) of both sexes were exposed to a physical stressor (electric current) and psychological active coping (mental arithmetic, free speech) and passive coping (unpleasant films) tasks, while indices of prestressor anxiety and task appraisal were measured. **Results:** Hypertensive women, but not men, showed diminished pain sensitivity, together with lower prestressor anxiety and a tendency to lower negative appraisal of the tasks, compared to their normotensive counterparts. In addition, positive correlations were obtained between pain sensitivity and negative appraisal of psychological stressors involving interpersonal threat (speech) and passive coping (films). **Conclusion:** Preliminary support has been obtained for extrapolation of diminished pain appraisal to appraisal of some psychological stressors (although for a part only in women); an important assumption in the operant conditioning hypothesis of hypertension.

Keywords: Appraisal; Hypertension; Pain sensitivity; Physical stressor; Psychological stressor

Introduction

Elevated blood pressure has repeatedly been found to be associated with diminished sensitivity to painful physical stimulation. This has been demonstrated for electrical [1], thermal [2], and finger pressure pain stimulation techniques [3]. Moreover, also in normotensive samples an inverse relationship between blood pressure and perceived painfulness of physical stressors has been reported [3]. This inverse relationship has been found in both between-subjects [4] and within-subjects designs [5], in animal [6] as well as in human studies [2]. Despite some occasionally conflicting findings [7,8], strong evidence has been obtained for the view that this association is a result of baroreceptor stimulation having dampening effects on the central nervous system [5,6,9]. These effects have been suggested to be already present in a normotensive subpopulation with enhanced risk for hypertension [9]. Partially based on these findings the following hypothesis has been proposed by Dworkin et al. [5]: given its pain-dampening properties, the baroreceptor stimulation mechanism may reinforce blood pressure elevations, which become operantly conditioned to occur in a wide range of potentially stressful situations. Persons sensitive to this mechanism who frequently encounter potentially stressful situations, may eventually develop essential hypertension [10]. An important, but to date not explicitly experimentally tested, assumption in this view is that hypertension-related aversiveness-dampening effects of baroreceptor stimulation found for *physical* stressors (i.e., painful stimuli) can be generalized to other stressors, including *psychological* stressors. Thus, the validity of this crucial assumption still has to be established. Until now, most studies in this field have been conducted on male subjects [2–4,9]. The few studies on pain sensitivity conducted on both sexes have yielded conflicting results. For instance, Fillingim and Maixner [11] found an inverse association between resting systolic blood pressure (SBP) and pain sensitivity only in men, not in women. In two other studies, however, partially a reverse effect was found: only in women, resting SBP and blood pressure reactivity to a

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speech task [12] and family history of hypertension [13] were associated with lower pain sensitivity. In light of these discrepancies, in the present study, sex differences were examined more systematically, both with respect to pain sensitivity and appraisal of psychological stressors. In the literature on hypertension and self-reported stress, diagnosis or awareness of hypertension has often been regarded as an important confounding variable. Whereas diagnosed hypertensives have been frequently found to report more medical symptoms [14,15] and more life stress [16] than individuals with normal blood pressures, undiagnosed or unaware hypertensives have sometimes been found to report even less medical symptoms [17,18] and life stress [19,20] than normotensive individuals. Although the baroreceptor mechanism — which has been suggested to be responsible for hypertension-related effects on pain appraisal [5,6] — is expected to be equally effective in aware and unaware hypertensives [5], in order to control for any potential confounding effect of hypertension awareness/diagnosis, in the present study both aware and unaware hypertensives were included.

Our objective was to investigate whether the diminished sensitivity to painful stimuli in hypertensives can be extrapolated to appraisal of psychological stressors. For this purpose, hypertensive and normotensive subjects were exposed to a physical stressor (electric current) and a variety of psychological stressors, namely: mental arithmetic (active coping and low level of social threat), free speech (active coping and high level of social threat), and viewing two film fragments (passive coping). It is expected that: (a) hypertensives have lower pain sensitivity, lower pretask anxiety, and appraise the stressors as less aversive than normotensives and (b) a high pain sensitivity is associated with negative appraisal of psychological stressors. No specific sex differences were anticipated.

Method

The present study forms a part of a larger project on hypertension and appraisal of stressors. The methods applied regarding selection of the participants and the pain stimulation conditions have been described extensively elsewhere [21] and will, therefore, be mentioned here only briefly.

Participants

From the pool of participants of the first part of the project, a large blood pressure screening study [22], a sample of 63 subjects was drawn to obtain three groups matched mainly on age and sex and as much as possible also on body mass index (BMI), alcohol use, smoking, physical exercise, and level of education. Both sexes were represented approximately equally in the resulting groups: 21 aware but untreated hypertensives, 21 unaware hypertensives, and 21 normotensives. The unaware hypertensive group consisted of participants whose elevated blood pressure was first discovered during the screening of the epidemiological study and, for the moment, was not yet told to the participants, unless the levels were very high ($>170/110$ mmHg). In the latter case, they were informed about the high pressure and discarded for the present laboratory study (this applied only to one person out of the eligible unaware participants). Exclusion criteria were use of antihypertensive medication, presence of diabetes mellitus, any form of kidney disease, a history of myocardial infarction or other heart disease, and use of any medication that may influence perception and mood. Definition of hypertension was based on the mean of at least three valid resting blood pressures measured using a valid automatic digital device (Philips HP 5330, based on the oscillometric method [22]) at the participants' homes in the population screening study. A mean SBP of at least 140 mmHg or a mean DBP (diastolic blood pressure) of equal to or higher than 90 mmHg was considered hypertensive.

Tasks

The participants performed a number of tasks in the same order as presented below. Most tasks were presented on the screen of a 486 SX-25 personal computer, which ran the complete session.

Music perception

A relaxing music fragment (new age) of 290-second duration was presented with the instruction to "just listen attentively to the music." In addition, after the music fragment, the participants had to complete a 12-item questionnaire about the perceived moods as expressed by the music [23]. This task was intended to be a fake task, providing an opportunity for the subjects to get familiar with performing a task in the present setting, resulting in a more relaxed state before starting the real tasks.

Pain stimulation

Constant electric current was delivered to the ventral side of the left forearm of the participants using a Tursky concentric electrode [24]. The current was a 60-Hz bipolar square pulse that could reach a maximum of 6 mA. The task consisted of three conditions presented in a fixed order: (i) self-controlled intensity regulation (the participants raised the stimulus intensity by themselves), (ii) slow automatic intensity regulation (stimulus intensity was raised automatically and slowly: maximum could be reached in 40 seconds), and (iii) fast automatic intensity regulation (stimulus intensity was raised automatically and rapidly: maximum could be reached in 4 s). In the first two conditions, participants were asked to indicate their pain threshold and pain tolerance. Given the very limited time in the last condition, the participants only had to indicate when the stimulus became painful. More details about this task can be found elsewhere [21].

Mental arithmetic

A mental arithmetic task based on the protocol used by Van Zijderveld et al. [25] was applied in the present study as an active coping psychological stressor. During 5 seconds, three consecutive one- or two-digit numbers appeared on the computer screen, which had to be added by the participant. Immediately after those three numbers, a fourth number appeared for a maximum of 2 seconds. The participants had to indicate whether that number expressed the sum of the three previous numbers and press the "correct" or "wrong" button accordingly. Participants were instructed to try to reach level 10 — the most difficult level — as quickly as possible and to stay at that level for as long as possible. Although this level was quite difficult to reach, the participants were told that level 10 "appeared to be reasonably well manageable by an average Dutch citizen," in order to enlarge the motivation of the participants. The task consisted of 6 (or if needed 12) practice trials and subsequent 30 trials that counted for the personal score.

Free speech

The second active coping task was a free speech task largely based on a protocol designed by Krantz et al. [26]. After a 90-second preparation, the participants had to speak in front of a camera for 3 minutes about their personal faults and undesirable habits. They were instructed not to talk about trivial things, but to be honest and open. Furthermore, they were encouraged to give an attractive presentation with a logical structure.

Films

The passive coping tasks consisted of just watching two film fragments depicting stressful everyday life scenes [27]. The first movie, called Accident (225 seconds), shows a women who gets her fingers badly cut when trying to mend a kitchen mixer. The second movie (Interruption; 690 seconds) is about a mechanic, who gets interrupted all the time while trying to repair a car, which he was told was an emergency task.

Measures

First, to get an impression of the psychological state of the participants, at the very start of the session, several questions were asked about the current participants' mood and how they experienced the day. The questions were largely based on the adjectives of the Profile of Mood States [28]. The list contained five questions about the past day and eight questions about the current mood of the participants. The questions were answered using five-point Likert scale ranging from 1 = *not at all* to 5 = *very much*.

An index of pretask anxiety was measured before each task — and in the case of the pain stimulation task also before each of the three conditions — by asking the question: "Are you feeling tense?," which was answered on a five-point Likert scale with the same range as above. The mean of all pretask values was used in the analyses.

Posttask appraisal of each task — including the three electric current conditions — was measured by asking the following three questions immediately after the tasks: "Did you appraise the task as unpleasant?," "Did you appraise the task as pleasant?," and "Did you appraise the task as stressful?" A total score of these three items (with the second one subtracted from the sum of the first and third) was used as a global index of negative posttask appraisal (mean Cronbach's α of these scales: .67). Given the fact that we hypothesized a global effect on negative appraisal, this sort of measure was preferred over more specific measures of negative appraisal related, for instance, to threat, hopelessness, etc. To check for the effects of feelings of controllability, the following additional question was asked: "To what extent did you feel in control during the task?" All questions were answered on the same five-point Likert scales as described above. In order to check whether blood pressure status had changed between the screening and the laboratory session, blood pressure was measured twice immediately before and twice after the session, using the same Philips HP 5330 automatic digital device as in the population screening home measurements described above [22]. Blood pressure status appeared to have changed in five participants: in four unaware hypertensives (three men and one woman), the values were in the normal range in the laboratory, for one normotensive woman the reverse was true. These five persons were excluded from all analyses.

Procedure

The participants were welcomed and seated in a comfortable chair. After an informed consent was obtained from the participants, blood pressure was measured twice with a 2-minute interval between the measurements. After on average 45 minutes after the participants entered the experiment room, the computer started the experimental program. Having completed the mood checklist (which on average took 91 seconds), the participants started with the music perception task. The "real" tasks followed after the first 5-minute rest period. All conditions were preceded by the pretask anxiety question and followed by the posttask appraisal questions and a rest period. Most rest periods had a duration of 5 minutes, except the rest periods between the electric current conditions, which were 90 seconds, and the last rest period, which was 10 minutes. The experiment lasted on average 120 minutes. After the experiment, blood pressure was again measured twice.

Statistical analysis

The following statistical analyses were performed using the SPSS statistical software package. First, differences between groups on background variables were tested by means of one-way analyses of variance. For tests within the

pain task conditions, Group × Sex × Condition multivariate repeated measures analysis of variance (MANOVA) were applied. A similar MANOVA was also used as an omnibus test for effects on poststressor negative appraisal of the various tasks. The multivariate approach to repeated measures analyses has been recommended by Vasey and Thayer [29], in order to prevent violation of the sphericity assumption. These analyses were complemented by Group × Sex ANOVA for pretask anxiety and for the negative appraisal after each task in isolation. In the analyses on mental arithmetic, the number of wrong answers was entered as a covariate, in order to control for this index of arithmetic skill. Interrelationships between pain sensitivity and stressor appraisal variables were examined by partial Pearson's Product–Moment Correlations between the two sets of variables, controlling for age and/or sex, if one or both of these variables showed a (marginally) significant correlation with the pain sensitivity variables. The correlation of the appraisal of mental arithmetic was additionally controlled for the number of wrong answers during this task. Because of the possibility of finding significant results in the direction opposite to that stated in the hypotheses, all tests were performed applying a two-tailed level of significance.

Results

No significant difference between the groups were found on any of the matching variables, although a trend appeared for a slightly higher BMI in the aware hypertensive group (see Table 1).

In each group, three persons were suspected to potentially have had cream leakage between the two parts of the electrode, as indexed by both extremely low resistance (below 0.5 kΩ) and reaching repeatedly the maximum possible current intensity during the trials. These participants were excluded from the analyses. For the speech task, the data of one participant were excluded from the analyses because of speaking for a too short period (less than 100 seconds).

Because the two hypertensive groups exhibited very similar scores for most variables regarding pain sensitivity, prestressor anxiety, and poststressor appraisal, data of these two groups were pooled in all analyses. This resulted in two levels of the between-subject factor group: hypertensives versus normotensives. The only clear difference between the hypertensive groups was revealed during analyses of the preexperiment mood items. One significant effect emerged, concerning reported irritation during the day [$F(2,55) = 3.58$, $P < .05$], indicating that aware hypertensives experienced the most feelings of irritation during the day (mean = 2.67, S.D. = 1.24), normotensives intermediate levels (mean= 2.00, S.D. = 1.12), and unaware hypertensives being the least irritated (mean = 1.76, S.D. = 0.83).

Pain sensitivity

The results with respect to pain sensitivity have been reported in detail elsewhere [21]. For the present article, the relevant finding was a significant Group × Sex interaction [$F(1,42) = 4.34$, $P < .05$] for pain threshold and a similar trend for pain tolerance [$F(1,43) = 3.77$, $P = .06$], which revealed that whereas no effects were found in males,

Table 1
Characteristics of the samples: means, standard deviations, and percentages

Variable	NT ($n = 20$)	UHT ($n = 16–17$)	AHT ($n = 20–21$)	F (P)
SBP[a]	119.8 (9.3)	145.9 (21.6)	157.5 (20.9)	23.33***
DBP[a]	78.7 (5.3)	97.2 (12.2)	103.9 (9.7)	39.58***
Age	44.8 (5.6)	44.1 (5.3)	43.5 (6.7)	0.26
Percent male	55.0%	52.9%	52.4%	0.01
BMI	24.4 (2.3)	24.9 (3.5)	26.7 (4.1)	2.66[#]
Partner[b]	95.0%	88.2%	95.2%	0.43
Education[c]	11.2 (3.5)	11.2 (2.9)	10.5 (3.3)	0.35
Employment[d]	80.0%	76.5%	76.2%	0.05
Smoking[e]	55.0%	58.8%	33.3%	1.50
Coffee[f]	5.55 (2.63)	6.19 (2.56)	4.67 (3.07)	1.40
Alcohol[g]	8.1 (9.0)	11.0 (8.7)	10.7 (12.4)	0.48
Sport[h]	1.10 (1.51)	1.06 (1.60)	1.20 (1.36)	0.04

NT = normotensives, UHT = unaware hypertensives, AHT = aware hypertensives. Percentages instead of means are reported for dichotomous variables.
[a] Values of SBP and DBP are means of pre- and postsession values.
[b] Percent married or living together.
[c] Years of education.
[d] Percent employed.
[e] Percent smoker.
[f] Cups per day.
[g] Glasses per week.
[h] Hours per week.
*** $P < .001$ (with Tukey's HSD post hoc tests revealing no significant differences between the two hypertensive groups).
[#] $P = .79$.

Table 2
Prestressor anxiety and poststressor negative appraisal: means and standard deviations

	Normotensives		Hypertensives		
Variable	Women ($n=7$)	Men ($n=10$)	Women ($n=15-16$)	Men ($n=16$)	F (P)
Pre: Anxiety	2.31	1.44	1.44	1.57	7.66**[a]
	(1.12)	(0.44)	(0.39)	(0.56)	
NegAppPHC	3.29	1.70	2.88	1.56	
	(1.80)	(2.11)	(1.78)	(2.50)	
NegAppPLC	4.07	2.25	3.19	2.63	
	(0.87)	(2.59)	(2.14)	(2.00)	
NegAppArithm	3.94	2.44	1.94	2.51	3.75[#]
	(3.13)	(3.93)	(3.26)	(2.63)	
NegAppSpeech	7.57	4.20	6.40	4.44	
	(2.15)	(3.55)	(2.32)	(2.83)	
NegAppFilms	2.07	1.20	−0.31	2.03	8.69**
	(2.26)	(0.92)	(1.40)	(2.28)	

NeggApP = negative appraisal, PHC = pain high-control, PLC = pain low-control. Sex main effects are not reported here; in the table, the most significant effect (always the Group × Sex interaction) is reported. When both Group × Sex interaction and Group main effect are significant, then the Group main effect is mentioned in this note.

[a] Also the Group main effect was significant [$F(1,45)=4.24$, $P<.05$].

[#] $P=.059$ (the underline reflects the omnibus test on negative appraisal across all tasks).

** $P<.01$.

among women, hypertensives had higher pain thresholds and tolerances than normotensives. There were no other significant effects involving group or the condition within-subject factor.

Controllability, prestressor anxiety, and poststressor appraisal

Since no differences were found between the two low-control pain conditions (Conditions 2 and 3), these conditions were pooled together. In addition, the data regarding the two passive psychological stressors (films) were pooled also.

The high- and low-control pain conditions differed on feelings of being in control in the expected direction: 4.55 (S.D. = 0.89) in the high-control and 3.98 (S.D. = 1.15) in the low-control condition [$F(1,47)=8.23$, $P<.01$]. Feelings of control also differed during the psychological stressors: 3.04 (S.D. = 1.00) during mental arithmetic, 2.61 (S.D. = 1.70) during speech, and 3.34 (S.D. = 1.42) during the films [Pillais exact test: $F(2,46)=3.56$, $P<.04$].

The means and standard deviations for prestressor anxiety and poststressor negative appraisal are shown in Table 2. A sex main effect indicated that women were more tense before the tasks than men [$F(1,45)=4.18$, $P<.05$]. Furthermore, the hypertensive groups reported less pretask anxiety than the normotensive group [$F(1,45)=4.24$, $P<.05$]. However, this was due to a difference among the women, not the men, as can be concluded from the significant Group × Sex interaction

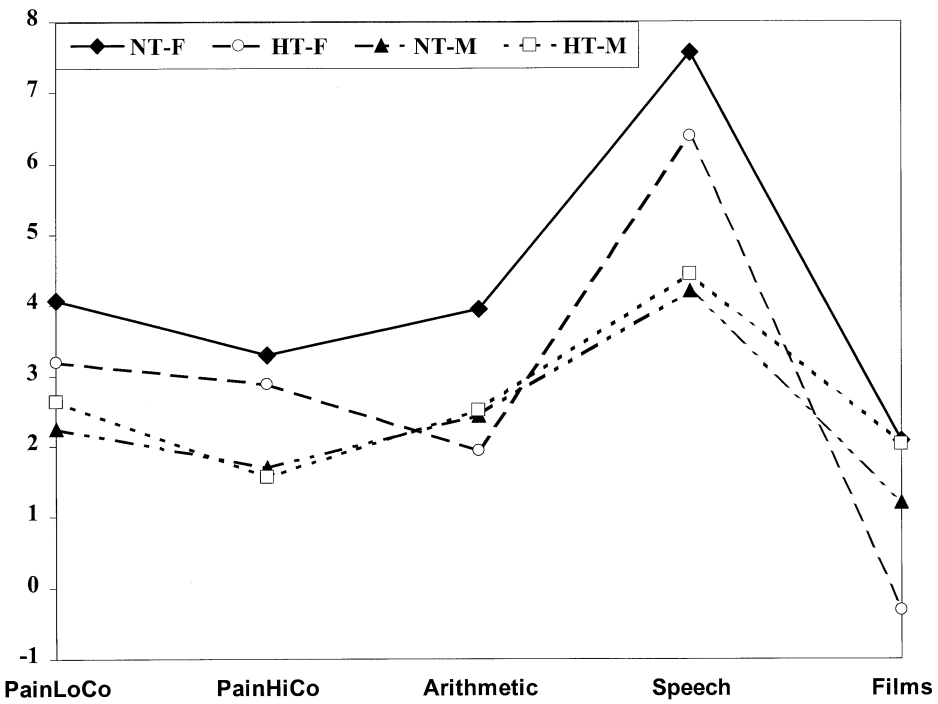

Fig. 1. Negative appraisal of the tasks by normotensive (NT) and hypertensive (HT) women (F) and men (M). PainLoCo = pain low-control task, PainHiCo = pain high-control task.

[$F(1,45) = 7.66$, $P < .01$] and inspection of the means in Table 2.

The omnibus test on posttask negative appraisal showed a significant condition main effect [Pillais exact test: $F(4,41) = 22.25$, $P < .001$], indicating the large differences in negative appraisal between the tasks (see Fig 1). A sex main effect [$F(1,43) = 5.65$, $P < .03$] showed that women rated the tasks more negatively than men. These sex differences were not present in all tasks, however, as revealed by a significant Condition × Sex interaction [Pillais exact test: $F(4,41) = 4.08$, $P < .008$]. Women appraised the high- and low-control pain conditions [$F(1,45) = 5.11$, $P < .03$, and $F(1,45) = 3.58$, $P = .065$, respectively], and especially the speech task [$F(1,44) = 9.99$, $P < .005$] as more negative than men, but not the other tasks. No group main effect emerged in the omnibus test [$F(1,43) = 1.66$, $P > .10$]. However, a nearly significant Group × Sex interaction [$F(1,43) = 3.75$, $P = .059$] revealed a trend similar to the one obtained in the analyses on prestressor anxiety: hypertensive women tended to rate the tasks less negatively than their normotensive counterparts, while men did not differ substantially (see Fig. 1 and Table 2). When the tasks were examined in isolation, this Group × Sex interaction reached significance only for the films [$F(1,45) = 8.69$, $P = .005$].

Relationship between pain sensitivity and poststressor appraisal

To examine the interrelationship between physical pain sensitivity and stressor appraisal, partial correlations were computed between these two sets of variables. The partial correlations were controlled for sex, which was the only control variable correlating with the pain sensitivity variables, and for the number of wrong answers in the case of mental arithmetic. Given the fact that the results were quite similar for pain threshold and pain tolerance and that these two variables were highly intercorrelated ($r = .85$ in the slow low-control condition and $r = .97$ in the high-control condition), these two variables were pooled into a new variable, called pain sensitivity (having consequently a reversed sign). The results are shown in Table 3. Prestressor anxiety did not correlate with pain sensitivity ($r < .15$, $P > .10$). For most tasks, correlations in the expected direction were found, ranging from $r = .28$, $P = .059$, for negative appraisal of the low-control pain condition with pain sensitivity in the high-control condition to $r = .47$, $P = .001$, for its pain sensitivity counterpart in the low-control condition and $r = .45$, $P = .002$, for negative appraisal of the films with pain sensitivity in the low-control condition. Only for negative appraisal of the high-control pain condition no significant correlations with pain sensitivity were found ($P > .10$) and negative appraisal of mental arithmetic even showed the reverse pattern: a negative association with pain sensitivity, especially when controlled for the number of wrong answers ($r = -.26$, $P = .081$, and $r = -.41$, $P = .005$ in the low- and high-control conditions, respectively).

Table 3
Partial correlations between pain sensitivity and anxiety and appraisal

	Pain sensitivity	
	Low control	High control
Pre: Anxiety		
NegAppPHC	.22	
NegAppPLC	.47**	.28#
NegAppArithm	−.26#	−.41**
NegAppSpeech	.33*	.31*
NegAppFilms	.45**	.39**

Pain sensitivity = reversed (−) mean of pain threshold and pain tolerance; see Table 2 for the explanation of the other variables. Shown are partial correlations controlled for sex and, in the case of mental arithmetic, for the number of wrong answers; $n = 43$ (speech)–44 (other tasks). Only correlations of at least .20 are shown.

# $P < .10$.

* $P < .05$.

** $P < .01$.

Discussion

The first main objective of the present study was to examine whether diminished sensitivity to physical (pain) stressors, which has been often found in hypertensives (for a review, see Ref. [30]) can be extrapolated to appraisal of psychological stressors, provided the diminished pain sensitivity in hypertensives would be replicated in the present study. Concerning the latter issue, the results were only partially conform the expectation: only female hypertensives showed lower pain sensitivity than their normotensive counterparts, whereas no difference was found in the male participants.

In line with the pain sensitivity results, only the female hypertensives exhibited lower scores on prestressor anxiety than their normotensive counterparts. With respect to poststressor appraisal, a similar overall trend was found, which reached significance only in the case of negative appraisal of the films: lower scores in female hypertensives compared to female normotensives. In addition, some substantial correlations in the predicted direction between pain sensitivity and poststressor negative appraisal emerged for most tasks in the whole group: lower pain sensitivity (higher pain threshold and tolerance) was associated with lower negative appraisal of the low-control pain task, the speech task, and the films. Surprisingly, the reverse pattern was obtained for the appraisal of mental arithmetic (especially after control for the number of wrong answers during the task) and no significant correlations were obtained for pretask anxiety. We have no satisfactory explanation for the mental arithmetic finding, apart from the fact that this task involves a specific high effort (active coping) component together with relatively low threat, which is quite opposite in nature to the passive coping–high threat electric pain stimulation task.

With respect to the nonsignificant correlations with pretask anxiety, one might speculate that it may be (at least partially) the result of problems related to restriction of range, since anxiety ratings were generally quite low (with the exception of normotensive women, approximately 1.5 on a scale from 1 to 5). In general, however, it may be concluded that some evidence for extrapolation of diminished pain sensitivity to self-reported appraisal of psychological stressors is obtained, mainly with respect to the ratings of the films and the free speech task. When the nature of these tasks is taken into account, controllability does not seem to play an important role, since the positive correlations between pain sensitivity and negative appraisal were obtained for both the task with the lowest (speech) and highest (films) feelings of controllability. The present findings suggest that extrapolation is rather in effect with respect to other *passive* stressors (films) or to stressors containing a strong component of *(social) threat* (free speech) [26], not to stressors promoting active coping without much (interpersonal) threat, such as the mental arithmetic task. If operant learning of blood pressure elevation is indeed an important factor in hypertension development [5], prospective studies on predicting long-term blood pressure elevations from laboratory stress reactivity and recovery preferably should use passive stressors or stressors containing high threat rather than a mental arithmetic task. Similarly, one may hypothesize that only real life stressors that are uncontrollable or that have a substantial (interpersonal) threat element may have the potential of contributing to tonic blood pressure elevations.

The profound sex differences, which were found in the between-group analyses, were not anticipated, although in the few previous studies with male and female participants substantial differences were also found with respect to pain sensitivity [11–13,31]. However, the results of those studies were not consistent. In two investigations, diminished pain sensitivity was related to higher resting blood pressure only in men [11,31], whereas in the two other studies only in women lower pain ratings were associated with higher blood pressure [12] or parental history of hypertension [13]. These discrepancies in findings are difficult to explain, with no clear sample differences or differences regarding pain modality (i.e., electric, thermal, pressure), which could account for the inconsistencies [21]. Regarding the present study, one might speculate that the design, in which all subjects had first full control over the electric stimulus, thereby diminishing anxiety, may have abolished group differences only among men (both male groups had low anxiety ratings) for some unknown reason. Obviously, more research has to be conducted on sex differences in the targeted relationships.

In addition, in order to examine the tentative mediating role of baroreceptor stimulation in the diminished appraisal of both physical and psychological aversive stimuli [5], the effects of experimental mechanic baroreceptor stimulation on the appraisal of different kinds of stressors should be assessed. For instance, the PRES neck suction technique, as recently developed by Rau et al. [32], seems a promising methodology to explore these relationships further.

No clear differences were obtained between unaware and aware hypertensives. In a way, this also would be expected, given the fact that, according to Dworkin at al.'s hypothesis [5], the baroreceptor stimulation mechanism should be equally effective in both groups. However, based on earlier studies on differences between these groups on self-reported problems and complaints (for an overview, see Ref. [33]), some differences were anticipated with respect to self-report variables, such as prestressor anxiety and poststressor appraisal. These differences, however, were not obtained in the present study. The only clear difference between both hypertensive groups was the score on self-reported experienced irritation during the day, which was high in aware hypertensives and low in unaware hypertensives, in line with previous findings [33]. No other effects of awareness of hypertension could be observed in this study.

A limitation of the present study involves the relatively small numbers of subjects, especially in the normotensive group. In the pain stimulation task, the number of subjects was reduced due to possible cream leakage in three normotensive and six hypertensive persons, as a result of which their data were discarded from the analyses. Although more participants may have resulted in stronger results for the female groups in the between-group analyses, this would probably not have altered the nonsignificant effects in men, since the means of their scores were not at all in the predicted direction. Nevertheless, the results should be interpreted with caution. In addition, perhaps in future research, more extensive and detailed (based on more than five-point scales) stressor appraisal ratings may result in stronger between-group effects on appraisal variables.

In summary, the present study demonstrated lower pain sensitivity, lower overall prestressor anxiety, and a tendency to lower negative appraisal of the tasks (being significant for the film task) in female hypertensives compared with their normotensive counterparts. In addition, a number of significant partial correlations between pain sensitivity and poststressor negative appraisal were obtained, especially with respect to appraisal of the speech stressor and the films. These outcomes provide some evidence for extrapolation of diminished appraisal of physical aversive stimuli to appraisal of psychological *passive* coping tasks (films) and tasks involving *interpersonal threat* (free speech), although the evidence is found mainly in women. Recommendations for future research include (a) directly testing the effects of baroreceptor stimulation on appraisal of both physical and psychological stimuli and (b) application of more extensive and detailed stressor appraisal ratings.

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